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The Fourth State

Newsletter of the Institute For Plasma Research, Gandhinagar, Gujarat (India)

IPR Wishes All Staff Members



A Very Happy New Year

IPR Annual Day

This year, the IPR Annual Day, aptly named “HARMONY- 2015” was organized on the 28th October at the IPR main campus. Encouraged by the overwhelming response from the staff members and their families which formed the audience, and the enthusiastic participants, this day was celebrated with a lot of activities – awards, music and dances. The Director, IPR Prof Dhiraj Bora, inaugurated the event along with Dr. Shishir Deshpande, Mr. P.K. Atrey, Mr. Vinay Kumar and Mrs. Chhaya Chavda by lighting the traditional lamp, which was followed by rendering of prayer by Dr. Anitha V.P. and Mr. Chandramouli Rotti.

The programme began with an enchanting song by Abhinav and Deep Vadher. The dance performances from young kids put a smile on the faces of the audience and their hearts fill with joy. There were several musical performances from IPR staff and their family members which left the audience spellbound. Anitha V. P and group presented an instrumental music performance using *veena*, *tabla*, *dholak* and *harmonium* which was enjoyed by one and all. Traditional *Garba* dance with live band followed the programme and the enthralled crowd danced away to glory ! Of course, after that sumptuous food was served to the tired, but definitely happy crowd !





Image collage of the events of the IPR Annual Day celebrations

The construction work for the major laboratories and auxiliary buildings sanctioned in the 12th plan has been started. The size of Laboratory Building is approximately 100 m x 50 m and it will have ground floor and two mezzanine floors. The size of auxiliary building is of approximately 80 m x 30 m. The total built-up area is approximately 17000 Sqm.



Excavation and dressing work in progress for the laboratory building (L) and its pump house (R) respectively.

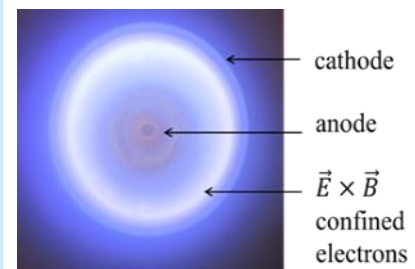
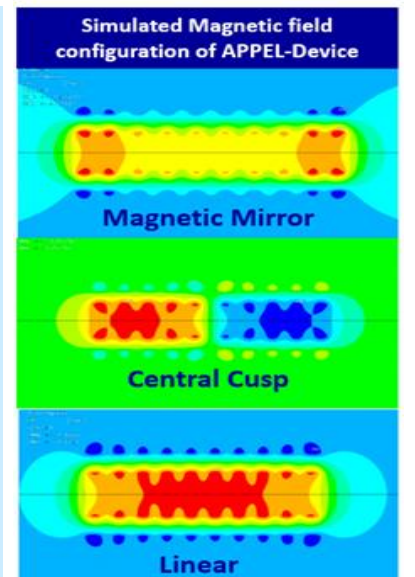
Magnetized Beam Plasma Surface Interaction Experiments

Plasmas generated for different applications are inevitably in contact with material surfaces. Phenomena springing from the interaction with material electrodes spans from the application of radio-frequency antennas for plasma heating and current drives in tokamaks to the surface production of negative hydrogen ions required for the neutral beam injector in fusion devices. In addition, the fate of plasma facing components exposed to massive heat flux has been a formidable concern for the steady state operation of fusion devices. Motivated from these frontline applications, a number of concurrent research activities have been initiated under the Magnetized Beam Plasma Surface Interaction Division. One major activity has been devoted to the development of a new linear plasma device called AP-PEL (Applied Plasma Physics Experiments in Linear Device).

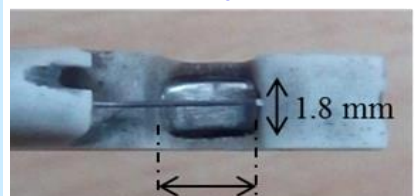
The objective of the activity is to facilitate basic experiments pertaining to the plasma wall interaction under steady state operating parameters, which are generally difficult to achieve in medium size tokamaks. The device will offer a flexible magnetic field configuration (mirror/cusp /linear) to cater the various innovative physics ideas and in parallel serve as a basic test bed for benchmarking different components/ diagnostics, prior to installation in fusion devices. For producing intense magnetized plasmas, a number of innovative concepts are being currently investigated. One principle mechanism for producing high density plasma is based on $E \times B$ confinement of secondary electrons by dc/array of radio-frequency driven electrodes. A pulsed plasma source is also being developed to investigate the transient behaviour of intense sub-microsecond plasma confined by mirror magnetic field. In contemporary with the above developments, a range of new plasma physics experiments have been initiated. A magnetized plasma column dominated by negative ions is being investigated to study the nature of cross-field transport across the magnetic field lines using a pin plane probe.

In conjunction an ambitious experiment to study the effect of surface produced negative ions on the sheath adjacent to a metal surface emitting electrons/ negative ions is under progress. These associated experiments involving the plasma source/ diagnostics are being carried out in an auxiliary linear device. In addition a capacitively coupled plasma has also been developed to study the interaction of radio-frequency sheaths in presence of oblique magnetic field.

This experiment has been initiated in association with National Center for Plasma Science and Technology, Dublin City University, Ireland under the ISCA, Science Foundation Ireland-India initiative.



Hollow cathode magnetron source



3.17 mm
Plane-Probe

A leave management portal named “PASTA” has been designed and developed in-house by the Institute. It has been officially launched on November 3, 2015 and made available to IPR, FCIPT and ITER-India deputation employees using URL <https://pasta.ipr.res.in>. The application has been designed to offer many facilities to the employees. Application is currently online with some basic features, and enhancements to this software will be offered in future. Present services for employee and admin department are as follows ;

- ◆ Personal details of the employee along with photograph.
- ◆ Accounting leaves.
- ◆ Online application of various types of leaves and intimation on the approval through email.
- ◆ View Holiday calendar.
- ◆ Daily attendance details (Access Control for employee signing IN / OUT).
- ◆ Manage personal scheduler.

In order to use the program, each employee has been assigned a User ID and login password by the Systems Administrator, which can be changed by the employee as per choice after first login. The portal has been launched on Secured gateway and can be accessed from any place around the globe enabling the employees to use the services round the clock.



Screenshots of the PASTA– leave management program

IPR @ Plasma-2015

Over 100 participants from IPR/FCIPT/ITER-India participated in the 30th National Symposium on Plasma Science & Technology (Plasma-2015) held at Saha Institute for Nuclear Physics, Kolkata during 1-4 December, 2015. The conference was inaugurated by Prof. Abhijit Sen, Prof. A K Mohanty (Director SINP) and Prof. D. K. Srivastava (Director VECC). Prof Sen gave the keynote address.

Of the several awards that were given during the conference, Dr. Ashwin Joy (formerly from IPR) was awarded the Parvez Guzdar young scientist award. While Harshita Raj, Jainish Topiwala, Akhil Jha and H L Swami were recipients of the Z.H Sholapurwala Poster awards for Fusion research, the winners of the PSSI Poster awards from IPR were G. Jhala, Lavkesh Lachhvani, Shivam Kumar Mishra, Shikha Binwal, Surabhi Jaiswal, and Ratan Kumar Behera. Our hearty congratulations to all the winners !



Professor Abhijit Sen lighting the lamp to inaugurate the Plasma-2015 at SINP Kolkata

The third outreach programme in the series being organized by IPR and GUJCOST was organized by the Community Science Center, at Rajkot during 8-9 December 2015. The programme was attended by more than 50 participants, which included teachers and students from various schools in and around Rajkot. The programme was inaugurated by the Director, Academics of CSC Rajkot, Retd. Prof. Ramesh Bhayani. He mentioned in his speech that many students from colleges in Rajkot are currently working in IPR. The two day programme had elementary talks on plasma & its applications by N Ramasubramanian, Chhaya Chavda, Shishir Purohit, Hiren Nimavat, K K Mohandas, Anand Vasani and Bharat Kumar. This was followed by hands-on experiments on glow discharge plasma as well as experiments with superconductivity and liquid nitrogen. The last day had a popular talk by Dr. Vinay Kamble followed by an interactive session with the participants. Resource materials and certificates were then distributed to all the participants.



Images of the scientific outreach programme held at the Regional Community Science Centre, Rajkot.

India @ ITER

The ITER cryostat is planned to be shipped from India in total 54 segments, which are going to be assembled / welded on-site. Out of this, the 12 segments that reached IO site in December 2016 included six 50- ton 60° segments, and six 19-ton main shell segments. They together form the base section of Cryostat whose total mass is about 3,850 tons, which will be the outermost chamber of ITER Tokamak. This delivery which was scheduled in the first quarter of 2016 was shipped ahead-of-schedule by IN-DA and were the first machine components to arrive at the ITER site. Welding operations in the dedicated Cryostat Workshop (about 5,500-square-metre) on the ITER site is expected to start in the summer of 2016.



IPR participated in the biennial Indian Particle Accelerator Conference (InPAC) organized by the Indian Society for Particle Accelerator (ISPA) at TIFR, Mumbai from 21-24 December, 2015. There were posters from the Accelerator, RFQ and FCIPT divisions of IPR. Arun Chakraborty from ITER-India gave an invited talk.

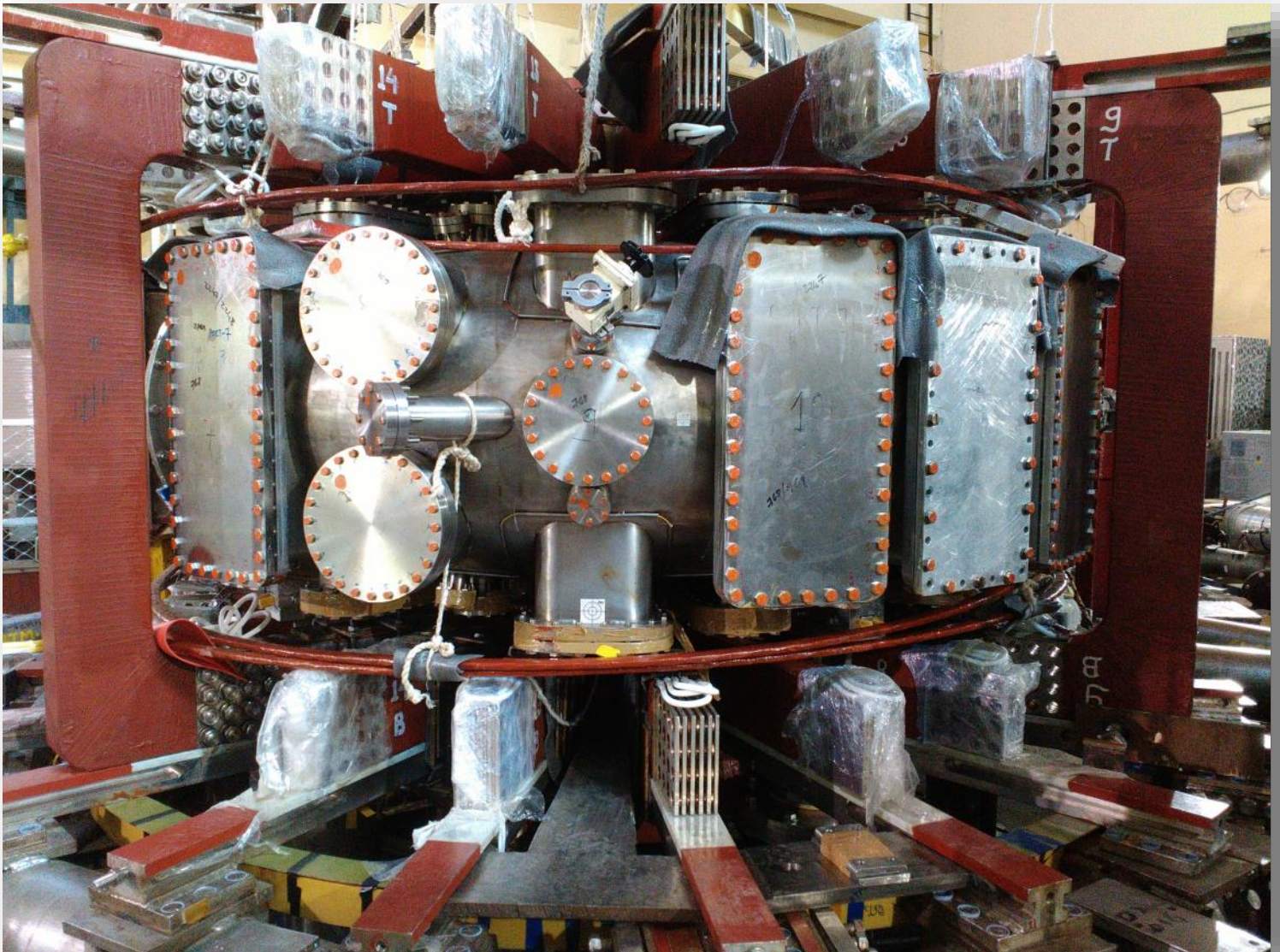


(L-R) K. K. Mohandas, Ravi A V Kumar, V Sivakumaran (Accelerator Division), Sumit Kumar, Renu Bahl and Mridula Mittal (RFQ Division) from IPR at their respective poster presentations.

Aditya Upgrade News

The two semi-tori assembly were joined form the complete toroidal vacuum vessel of Aditya. The inner divertor coils were placed on the supports fabricated on the vessel. The vacuum vessel was evacuated and helium leak test carried out. All the joints of the vessel were checked for helium leak rate of 10^{-9} mbar-l/sec, and the assembly was found to have no leaks.

After removing the temporary platform, the vessel was rested on the four vessel supports situated at 0° , 90° , 180° and 270° . The critical alignment of the vacuum vessel was carried out with respect to Ohmic coil (TR1) with the help of ECDS measurements. The system was finally mounted in its desired position inside Aditya Tokamak structure.



The completed torus of Aditya placed in its support structure. Two of TF coils (at the two sides) are also seen as connected to form whole coils.

Dr. Mukesh Ranjan of FCIPT Gandhinagar has been conferred The “**Young Achiever Award**” at the 60th DAE Diamond Jubilee Solid State Physics Symposium. The award has been conferred recognising his outstanding scientific contributions in the field of plasma material interaction induced self-assembled nano-patterns and their various applications. The Young Achiever Award is given to scientists of age below 40 years and having at least 3 years of research experience after their Ph.D. degree.

Dr. Ranjan completed his MSc from IIT Roorkee in 1999 and M.Tech in 2001 from IIT Kanpur (Nuclear Engineering and Technology) and joined IPR in March 2002 in the FCIPT division of IPR. He started his work at IPR on various plasma diagnostics and plasma processing related projects. He completed his PhD during 2007-2010 from Ion Beam and Material Research

Centre, HZDR, Dresden (Germany).

On his return to FCIPT, he began working in the field of plasma material interaction and nano-patterning with ion beams and their various applications. He has successfully completed around 22 national and international research projects on various plasma based technologies. He has also authored over 26 international publications in journals and books.

Our hearty congratulations to Dr. Ranjan !



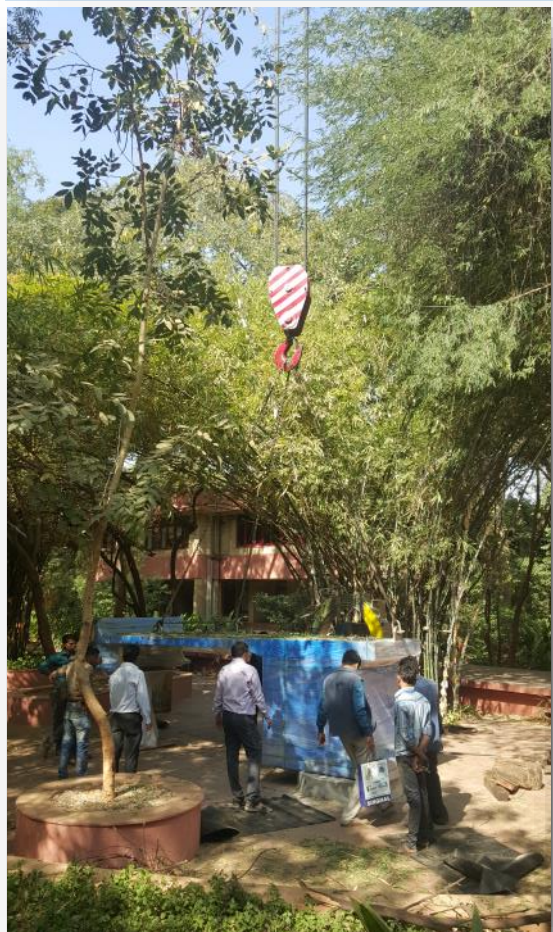
OSMY Award 2015



The Outstanding Staff Member of the Year (OSMY) for 2015 has been awarded to **Mr. Subrat Kumar Das**. Mr. Das has been working with the Magnet Technology Development Division of IPR since the last 3 years as Technical Assistant-B. He has been extensively involved in the indigenous development of advanced superconductor materials like MgB₂ (magnesium diboride) and Nb₃Al (niobium aluminium) and their *in-situ* fabrication methods.

Our hearty congratulations to Mr. Subrat Kumar Das !

Science Park @ IPR



In order to showcase the major technological advances of IPR in the areas of plasma & fusion science & technology in the past 29 years of its existence, a permanent science park is planned to be established at IPR. This open area park will have permanent exhibits of items that are related to the R&D work that has been carried out at IPR. Some of the planned exhibits are (a) 1/4 sector of old “Aditya” vacuum vessel showing RF antenna and some diagnostics that was used in India’s first indigenous tokamak (b) SST-1 and Aditya toroidal coils (c) ITER cryostat base mock-up (d) Zircon sand dissociation reactor to produce zirconium (e) Scrap plates from the fabrication of actual in-wall components for ITER (f) Cryo-pump components (g) Table-top tokamak.

This park will also have posters and plaques to describe the exhibits and their role in the R&D carried out at IPR.



Placing the 10-ton ITER cryostat mockup at the science park location at IPR

- ♦ **Dr. Kailash Chandra Meher**, Bhabha Atomic Research Centre, Mumbai, gave a talk on “Study of Thermal, Electrical and Fluid Dynamic Behaviour of Arc Plasma Devices” on 8th December 2015
- ♦ **Ms. Manjit Kaur**, Institute for Plasma Research, Gandhinagar, gave a talk on “Self-organized dust Rotation in an unmagnetized DC Glow Discharge” on 11th December 2015
- ♦ **Ms. Alphonsa Joseph**, Institute for Plasma Research, Gandhinagar, gave a talk on “Influence of Structure of Stainless Steels on Plasma Nitriding and Nitrocarburizing for Improving Hardness and Corrosion Resistance” on 18th December 2015

Upcoming Events

- ♦ Emerging Trends in Advanced Functional Materials (ETAfM 2016), Institute of Physics, Bhubaneswar, 18-21 January 2016 <http://www.iopb.res.in/etafm2016/>
- ♦ Monaco ITER International Fusion Energy Days (MIIFED) and ITER Business Forum (IBF), Monaco, 8-11 February 2016 <http://www.miifed-ibf2016.com/>
- ♦ Gaseous Electronics Meeting (GEM 2016), Geelong, Victoria, Australia, 14–17 February 2016 <https://blogs.deakin.edu.au/gem2016/>
- ♦ Conference on High Intensity Lasers and attosecond science in Israel (CHILI 2016), Israel, 22-24 February 2016 <http://electron.tau.ac.il/~ipom/chili2016/>
- ♦ Exploratory Plasma Research Workshop, Auburn University, Auburn, Alabama USA, 23-26 February 2016 <http://www.iccworkshops.org/>

Know Our Colleagues



Dr Subrata Pradhan Joined the institute as a Technical Trainee student in 1989, as a doctoral student in 1990 and as a scientist in 1995. He is currently leading the Steady State Superconducting Tokamak (SST-1) program as well as the Magnet Technology Division. He has been visiting researcher at National High Magnetic Field Laboratory (USA) and Kurchatov Institute of Atomic Energy, Moscow. He is also an honorary professor at the Institute of Superconductivity and Electronic Materials at University of Wollongong, Australia. He is also the recipient of the 'Buti Foundation Award 2013' by the Physical Research Laboratory, Ahmedabad, for his outstanding contributions to Plasma Sciences and Technology in India. He has also been conferred the 'Scientific Research Council Outstanding Investigator Awardee' of the Department of Atomic Energy (DAE-SRC OI) in recognition of his outstanding contributions to plasma sciences and technologies.

Dr. Debasis Chandra joined IPR in 1992 as a research scholar and became permanent staff from 1995. Initially, he worked on Plasma Processing Experiment as a research scholar and then on SST1 magnets. He has worked on the physics description of SST1 tokamak. His work on the effect of plasma rotation on tearing modes is well appreciated. He received PhD degree in this field from this institute. Currently, he is a member of the Fusion Theory and simulation group, and is involved in tokamak MHD plasma simulations.



Mr. Haresh Dave joined the institute in 1994 as a trainee in the first batch of Technical Training Programme and later as a permanent staff in 1995 in the Data Acquisition and Control Group of SST-1. He was involved in design and development of the SST-1 Data Acquisition and Control systems. He had an opportunity to work in the CODAC Division of ITER, Cadarache, France from 2007 to 2010. Currently he is working with the Large Cryo-Plant and Cryo-System (LCPC) division.



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